

What Is Claimed Is:

1. A suturing instrument for joining a first  
portion of material to a second portion of material,  
5 said suturing instrument comprising:

a handle;

an end effector mounted on said handle and  
defining therein:

a first channel for supporting suture wire,  
10 said first channel being curved to impart a looping  
configuration to portions of the suture wire passed  
therethrough;

a second channel adapted to receive the  
looped suture wire emerged from said first channel;  
15 and

a passageway for supporting a cutting bar,  
said passageway intersecting said first channel so as  
to create a first island between said first channel  
and said passageway, and said passageway intersecting  
20 said second channel so as to create a second island  
between said second channel and said passageway;

a wire advancing actuator mounted on said handle for moving the suture wire through said first channel, through the material first and second portions and back into said second channel;

5 a cutting bar movably disposed in said passageway for selectively engaging the suture wire, said cutting bar being adapted to (1) cut the looped suture wire from the remaining portions of the suture wire; (2) bend the trailing end and the leading end of the  
10 looped suture wire around said first island and said second island; and (3) lift the looped suture wire over said first island and said second island; and

a cutting bar actuator mounted on said handle for moving the cutting bar into engagement with the suture  
15 wire.

2. A suturing instrument according to claim 1 wherein said cutting bar is further adapted to push the looped suture wire past said first island and said  
20 second island after the looped suture wire has been lifted.

3. A suturing instrument according to claim 1  
wherein said second channel includes a curved surface  
for guiding the looped suture wire emerged from said  
5 first channel.

4. A suturing instrument according to claim 1  
wherein said end effector is provided with a recessed  
cutout therein such that pressing said end effector  
10 against a pliable portion of material causes the  
bulging portion of material into the recessed cutout,  
to permit deep penetration of the suture wire.

5. A suturing instrument according to claim 1  
15 wherein said end effector includes at least one  
projection extending out of said end effector for  
engaging the portion of material.

6. A suturing instrument according to claim 5  
20 wherein said end effector includes two projections

extending out of said end effector for engaging the  
portion of material.

7. A suturing instrument according to claim 6  
5 wherein one of said projections is longer than the  
other of said projections.

8. A suturing instrument according to claim 1  
wherein said cutting bar comprises (1) a cutting face  
10 for cutting the looped suture wire from the remaining  
portions of the suture wire; (2) a relief face for  
bending the trailing end and the leading end of the  
looped suture wire around said first island and said  
second island; and (3) an ejection ramp face for  
15 lifting the looped suture wire over said first island  
and said second island.

9. A suturing instrument according to claim 10  
wherein said cutting bar further comprises an ejection  
20 push face to push the looped suture wire past said  
first island and said second island after the looped

suture wire has been lifted over said first island and  
said second island.

10. A suturing instrument according to claim 1  
5 wherein said first portion of material comprises  
tissue and said second portion of material comprises  
tissue.

11. A suturing instrument according to claim 1  
10 wherein said first portion of material comprises a  
prosthesis and said second portion of material  
comprises tissue.

12. A suturing instrument according to claim 11  
15 wherein said first portion of material comprises  
surgical mesh and said second portion of material  
comprises tissue.

13. A suturing instrument according to claim 1  
20 wherein said first island and said second island are

each separated from said passageway by at least the thickness of the suture wire.

14. A suturing instrument according to claim 1  
5 wherein said first channel and said second channel are undercut so as to help retain the suture wire in said first channel and said second channel, respectively.

15 10 15. A suturing instrument according to claim 1 wherein said wire advancing actuator is adapted to advance a predetermined length of suture wire.

16. A suturing instrument according to claim 1  
15 wherein said wire advancing actuator and said cutting bar actuator are sequentially activated by a single element.

17. A suturing instrument according to claim 1  
20 wherein said second channel has a geometry such that the suture wire is maintained in said second channel

until after the suture wire has been cut and partially bent.

18. A suturing instrument according to claim 1  
5 wherein said cutting bar cuts the suture wire so as to form a sharp point.

19. A suturing instrument according to claim 1  
10 wherein said end effector is detachable from said handle so as to allow a different end effector to be mounted to said handle.

20. A suturing instrument according to claim 1  
15 further comprising a wire supply cartridge for housing, dispensing and supporting the suture wire being advanced to said first channel.

21. A structure for supporting suture wire  
20 during driving of the suture wire, said structure comprising:

a first tube for closely surrounding and slidably supporting the suture wire;

5 a first pair of diametrically opposed openings formed in said first tube for exposing the suture wire for driving, said first pair of diametrically opposed openings being sized sufficiently small so as to maintain support for the suture wire;

a second tube disposed about a portion of said first tube; and

10 a second pair of diametrically opposed openings formed in said second tube, said second pair of diametrically opposed openings being aligned with said first pair of diametrically opposed openings , and said second pair of diametrically opposed openings  
15 being sufficiently small so as to maintain support for said first tube.

22. A method for joining a first portion of material to a second portion of material, said method  
20 comprising:

providing a suturing instrument comprising:



a handle;

an end effector mounted on said handle and  
defining therein:

a first channel for supporting suture  
5 wire, said first channel being curved to impart a  
looping configuration to portions of the suture wire  
passed therethrough;

a second channel adapted to receive the  
looped suture wire emerged from said first channel;  
10 and

a passageway for supporting a cutting  
bar, said passageway intersecting said first channel  
so as to create a first island between said first  
channel and said passageway, and said passageway  
15 intersecting said second channel so as to create a  
second island between said second channel and said  
passageway;

a wire advancing actuator mounted on said  
handle for moving the suture wire through said first  
20 channel, through the material first and second  
portions and back into said second channel;

a cutting bar movably disposed in said passageway for selectively engaging the suture wire, said cutting bar being adapted to (1) cut the looped suture wire from the remaining portions of the suture wire; (2) bend the trailing end and the leading end of the looped suture wire around said first island and said second island; and (3) lift the looped suture wire over said first island and said second island; and

a cutting bar actuator mounted on said handle for moving the cutting bar into engagement with the suture wire;

positioning said end effector against at least one of the portions to be joined;

moving the suture wire through said first channel, through the material first and second portions and back into said second channel; and

moving the cutting bar in said passageway so as to (1) cut the looped suture wire from the remaining portions of the suture wire; (2) bend the trailing end of the looped suture wire around said first island and

said second island; and (3) lift the looped suture wire over said first island and said second island.

23. A method according to claim 22 wherein said  
5 cutting bar is further adapted to push the looped suture wire past said first island and said second island after the looped suture has been lifted, and further wherein the step of moving the cutting bar in said passageway includes pushing the looped suture  
10 wire past said first island and said second island after the looped suture has been lifted.

24. A method according to claim 22 wherein said end effector is provided with a recessed cutout  
15 therein, and further wherein the step of positioning said end effector against at least one of the portions to be joined causes a bulging portion of material to enter the recessed cutout, to permit deep penetration of the suture wire.

20

25. A method according to claim 22 wherein said  
end effector includes at least one projection  
extending out of said end effector for engaging the  
portion of material, and further wherein the step of  
5 positioning said end effector against at least one of  
the portions to be joined includes engaging said at  
least one of the portions with said at least one  
projection.

10 26. A method according to claim 22 wherein the  
step of positioning said end effector against at least  
one of the portions to be joined includes positioning  
said end effector at an acute angle to the surface of  
the portion.

15 27. A method according to claim 22 wherein said  
first portion of material comprises tissue and said  
second portion of material comprises tissue.

28. A method according to claim 22 wherein said first portion of material comprises a prosthesis and said second portion of material comprises tissue.

5           29. A method according to claim 22 wherein said first portion of material comprises surgical mesh and said second portion of material comprises tissue.

10           30. A method according to claim 22 wherein said first island and said second island are each separated from said passageway by at least the thickness of the suture wire, and further wherein the step of moving the cutting bar in said passageway includes bending the trailing end of the looped suture wire around said  
15 first island and said second island includes bending the trailing end and the leading end of the looped suture wire between said first island and said second island and said passageway, respectively.

31. A method according to claim 22 wherein the step of moving said suture wire includes advancing a predetermined length of suture wire.

5           32. A method according to claim 22 wherein said wire advancing actuator and said cutting bar actuator are sequentially activated by a single element.

10           33. A method according to claim 22 wherein the suture wire is maintained in said first island and said second island until after the suture wire has been cut and partially bent.

15           34. A method according to claim 22 wherein the suture wire is cut so as to form a sharp point.

20           35. A method according to claim 22 wherein the step of providing a suturing instrument comprises selecting a particular end effector from a set of different end effectors and mounting the selected end effector on said handle.

36. A method according to claim 22 wherein the suture wire is initially contained in a wire supply cartridge for housing, dispensing and supporting the suture wire being advanced to said first channel, and further wherein the step of providing a suturing instrument includes loading the wire supply cartridge into said housing.

37. A method for driving wire, said method comprising the steps of:  
providing a structure for supporting suture wire during driving of the suture wire, said structure comprising:

a first tube for closely surrounding and slidably supporting the suture wire;

a first pair of diametrically opposed openings formed in said first tube for exposing the suture wire for driving, said first pair of diametrically opposed openings being sized

sufficiently small so as to maintain support for the suture wire;

a second tube disposed about a portion of said first tube; and

5 a second pair of diametrically opposed openings formed in said second tube, said second pair of diametrically opposed openings being aligned with said first pair of diametrically opposed openings, and said second pair of diametrically  
10 opposed openings being sufficiently small so as to maintain support for said first tube; and

engaging the suture wire with a pair of opposing rollers, each of the opposing rollers engaging the suture wire by accessing the suture wire through one  
15 of the second pair of diametrically opposed openings and one of the first pair of diametrically opposed openings.